



Antique Wireless Association of Southern Africa Newsletter



232

November 2025



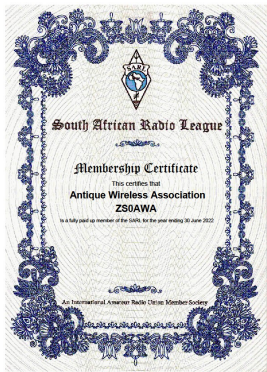
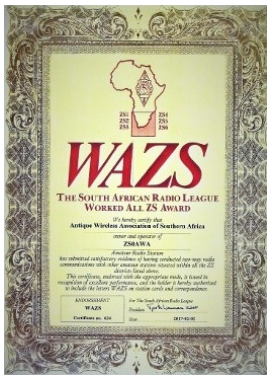
Heathkit SB-401

Manufactured from 1966, the Heathkit Model SB-401 SSB Transmitter is capable of SSB (Upper and Lower side-band) and CW operation on all amateur bands from 3.5 to 30 megahertz. A crystal controlled heterodyne oscillator and a preassembled, pre-aligned linear master oscillator insure highly accurate and stable operation.

Complete transceive capabilities are available when the transmitter is used with the Heathkit model SB-300, SB-301 or SB-303 receivers. The transmitter can also be used with other receivers by installing the SB-401-1 Crystal accessory kit in the transmitter. This transmitter is compatible with the Heathkit model SB-200 SSB Linear Amplifier.

Other operating features include: Voice operated (VOX) and push to talk (PTT) control in the SSB mode; break in keying in the CW mode; Built in antenna change over relay; switched 120V AC to operate an external relay; crystal filter type SSB generator and automatic level control to prevent distortion while providing high talk power. The large circular dial has calibration marks every kilohertz and covers 100 kilohertz for every revolution to provide a bandwidth equal to approximately 10 feet per megahertz. A slide rule type dial pointer clearly indicates the number of rotations of the circular dial. The knob to dial ratio is approximately 4:1. Final output is two 6146 tubes.

All aluminium metal parts provide light weight and sturdy construction. Assembly time saving features include circuit boards, wiring cable assemblies, and a preassembled LMO tuning unit. The transformer operated silicon diode power supply is a long-life, low-heat power source.



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AWA Committee:

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- * Secretary/PRO—Andy ZS6ADY
- * KZN—Don ZS5DR
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Chris's Musings

There's a post going around from an American ham bemoaning the state of amateur radio. He starts his rant with: "*Ham Radio is Dying - not because of the internet, or technology, or 'kids these days' ... It's dying because of us! And before you blame the FCC, the internet or kids these days, let's be honest!*"

The gist of his rant is that the older hams are not doing enough to encourage the younger generation to get involved! He has a point. This year, more than a hundred people studied for the RAE, passed their exam and were licenced. But where are they?

When I was in my teens and twenties, I was mentored. The owner of the local radio repair shop welcomed me into his shop. He took the time to explain what he was doing and taught me to fix radios. He gave me old scrap which I could strip for parts and turn into home brew projects. When I was older and developed an interest in ham radio, a number of local hams took me under their wings, invited me into their shacks and taught me more. And when I was ready for the RAE, Theo Carlson ZS1P became my mentor. George Clark ZS1CS, the local Heathkit distributor offered me the chance to build kits for those who bought one but did not want to build it. He introduced me to Tippy Marais, ZS1CL who took the time to teach me the Morse Code. And that's how I got to be a radio amateur.

So, what is my point? Every year, in excess of a hundred people of all ages take the RAE, pass and then are licenced. But how many keep up their hobby or are heard on the bands. Many seem to end up operating CB, so this says that they have an interest in communicating. These new hams are just turned loose and left to fend for themselves. The HF assessment does not give them enough immersion, confidence or the experience they need to hold their interest. As a community, it seems like we just could not be bothered or worse still we are judgemental

Richard Dismore, F4WCD, formerly ZS6TF in reply to the post said: "*The [recent] ESR discussion is evidence that the AWA is not afraid of technology. We live in it also and are not afraid to harness it to our core interest as expressed in the mission statement and followed through on the nets with its relays, newsletter, website and this telegram group. OK not perfect, William has drawn attention to the falling use on air of yesterdays radios etc and has done something about it personally. If everyone did something personally about the criticisms of that post it wouldn't be a problem. It is all about us*".

Why are we, the active amateur community not making more of an effort to involve the new hams in activities? A few clubs are doing a good job and are very active with field days, summits on the air, equipment construction and participating in contests. But where are the individual hams like us? Why aren't we taking the new hams under our wings and involving them in our activities. Why don't we invite them into our shacks? Why not make an effort to befriend a new ham in your neighbourhood and involve them in your activities? Or, make an effort participate in your local club activities and invite along a new ham to come with you?

Chris ZS6GM



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Reflections:

In my days working on the diamond mine, I was asked by the chief instrument technician "How many techies does it take to change a light bulb?"

Of course these guys were always of great interest to me in that anything above 110v, the power supplied from the control rack, for starting and stopping virtually anything in the entire process in the plant, was considered HT. So when I conversed with them about repairing and restoring my Hallicrafters HT37 that had such high voltages running from the transformer, they would not even attempt to assist me in any way.

Never mind the fact that there was an 11000v capacitor that sat right in the front of the cabinet on an X-Ray machine used in the diamond recovery process. Capacitors it seemed were part and parcel of the make up of components used in the circuits. This of course was very confusing to me, especially the day that one same capacitor put me flat on the ground after reaching in to the cabinet to reset a breaker.

I must tell you that after that I became very aware of the dan-

gers of high voltage in any cabinet. Be it in a transmitter or in a control cabinet of a machine.

No one had to tell me again about making sure that all capacitors were grounded or at least given the opportunity to discharge before working on anything, and that the bypassing of safety features was a no no.

Of course one tends to forget about the actual voracity of any experiences like being shocked, unless your heart stops of course, and then we tend to take short cuts, bridge out safety features so that we can work on things without having to close the cabinet every time.

Somehow, I think the memory remains, but the pain is forgotten.

In the modern radios of today, there are no high voltages to worry about and the worst one can maybe get is an RF burn from transmitting into a dummy load and touching in the wrong place.

There has been quite a bit of discussion on the Telegram group and on our Saturday morning net around the testing and changing out of capacitors. Reference has been made again to using ways of testing capacitors and about the use of an ESR tester which one can find on the website.

As a follow up to the AWA SSB

Valve QSO Party, it was quite disappointing to only receive one log for the last session in October.

There were a few people who participated, but only one person took the time to submit a log. Many things go through my mind at times like this but I shall reserve those comments for myself, before I get told I am just whinging again.

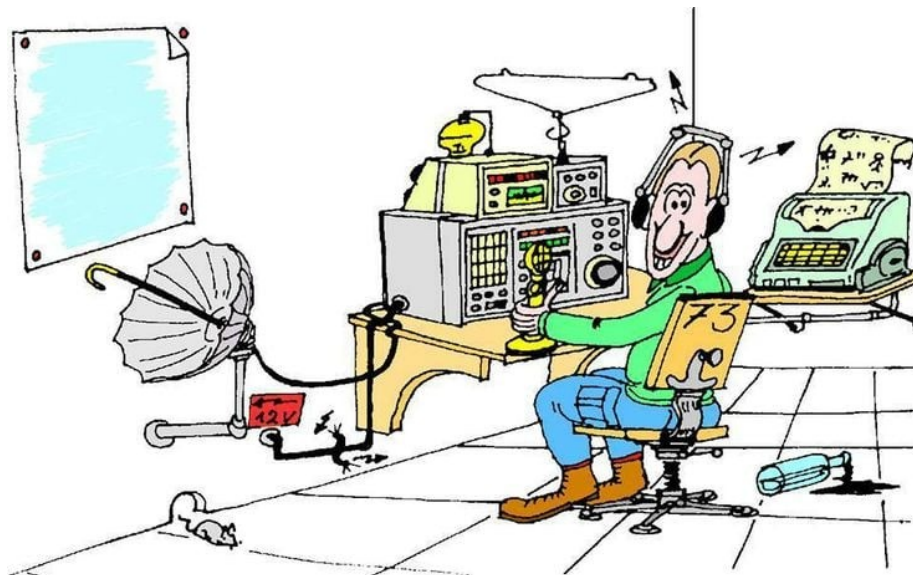
Hopefully next year with a change in the format of the QSO Party, it might attract more participation. We can only hope.

Lastly, a request to as many of you as possible, to attend the AGM at the SAIEE. It's a good time to meet up with all the voices you hear on the air and is certainly not a long way to drive for those of you who are local. Plus there is the opportunity to see the Museum at SAIEE and the shack with all its memorabilia.

We will be on stream for those of you who cannot get there and the link will be posted.

Best 73

De Andy ZS6ADY



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Antique Wireless Association of Southern Africa

AWA AGM – 2025

Notice is given for the 2025 AGM of the Antique Wireless Association of Southern Africa to be held on Saturday 15th November 2025 at the premises of the SAIEE in Observatory Johannesburg.

There will be a fleamarket and open display as well as free access to the SAIEE museum.

The SAIEE shack will be available for use.

Times will be from 09:00 until 15:00 with the AGM held at approximately 10:00, thereafter fleamarket and braai facilities and eyeball QSO. Bring along all your valuable junk that you wish to dispose of at the fleamarket.

The Shack will be on air from 08:30.

Should you wish to bring your own meat and refreshments, please feel free to do so, otherwise meat packs and cold drinks will be on sale.

Please let Andy ZS6ADY know if you would be interested in a meat pack, for planning purposes.

We look forward to seeing many of you there.

Kind regards

Andy Cairns ZS6ADY
(Secretary/PRO AWA)

A History of Capacitors



In October 1745, Ewald Georg von Kleist of Pomerania, Germany, found that charge could be stored by connecting a high-voltage electrostatic generator by a wire to a volume of water in a hand-held glass jar. Von Kleist's hand and the water acted as conductors and the jar as a dielectric (although details of the mechanism were incorrectly identified at the time). Von Kleist found that touching the wire resulted in a powerful spark, much more painful than that obtained from an electrostatic machine. The following year, the Dutch physicist Pieter van Musschenbroek invented a similar capacitor, which was named the Leyden jar, after the University of Leiden where he worked. He also was impressed by the power of the shock he received, writing, "I would not take a second shock for the kingdom of France."

Daniel Gralath was the first to combine several jars in parallel to increase the charge storage capacity. Benjamin Franklin investigated the Leyden jar and came to the conclusion that

the charge was stored on the glass, not in the water as others had assumed. He also adopted the term "battery", (denoting the increase of power with a row of similar units as in a battery of cannon), subsequently applied to clusters of electrochemical cells. In 1747, Leyden jars were made by coating the inside and outside of jars with metal foil, leaving a space at the mouth to prevent arcing between the foils. The earliest unit of capacitance was the jar, equivalent to about 1.11 nanofarads.



Advert from the 28 December 1923 edition of The Radio Times for Dubilier condensers, for use in wireless receiving sets

Leyden jars or more powerful devices employing flat glass plates alternating with foil conductors were used exclusively up until about 1900, when the invention of wireless (radio) created a demand for standard capacitors, and the steady move to higher frequencies required capacitors with lower inductance. More compact construction methods began to be used, such as a flexible dielectric sheet (like oiled paper) sandwiched between sheets of metal foil, rolled or folded into a small package.

Early capacitors were known as *condensers*, a term that is still occasionally used today, particularly in high power applications, such as automotive systems. The term *condensatore* was used by Alessandro Volta in 1780 to refer to a device, similar to his electrophorus, he developed to measure electricity, and translated in 1782 as *condenser*, where the name referred to the device's ability to store a higher density of electric charge than was possible with an isolated conductor. The term became deprecated because of the ambiguous meaning of steam condenser, with *capacitor* being recommended by the British Engineering Standards Association in 1926, although it took several decades for the term to predominate.

Since the beginning of the study of electricity, non-conductive materials like glass, porcelain, paper and mica have been used as insulators. Decades later, these materials were also well-suited for use as the dielectric for the first capacitors. Paper capacitors, made by sandwiching a strip of impregnated paper between strips

of metal and rolling the result into a cylinder, were commonly used in the late 19th century; their manufacture started in 1876, and they were used from the early 20th century as decoupling capacitors in telephony.

Porcelain was used in the first ceramic capacitors. In the early years of Marconi's wireless transmitting apparatus, porcelain capacitors were used for high voltage and high frequency application in the transmitters. On the receiver side, smaller mica capacitors were used for resonant circuits. Mica capacitors were invented in 1909 by William Dubilier. Prior to World War II, mica was the most common dielectric for capacitors in the United States.

Charles Pollak (born Karol Pollak), the inventor of the first electrolytic capacitors, found out that the oxide layer on an aluminum anode remained stable in a neutral or alkaline electrolyte, even when the power was switched off. In 1896 he was granted U.S. Patent No. 672,913 for an "Electric liquid capacitor with aluminum electrodes". Solid electrolyte tantalum capacitors were invented by Bell Laboratories in the early 1950s as a miniaturized and more reliable low-voltage support capacitor to complement their newly invented transistor.

With the development of plastic materials by organic chemists during the Second World War, the capacitor industry began to replace paper with thinner polymer films. One very early development in film capacitors was described in British Patent 587,953 in 1944.

Electric double-layer capacitors (now supercapacitors) were invented in 1957 when H. Becker developed a "Low voltage electrolytic capacitor with porous carbon electrodes". He believed that the energy was stored as a charge in the carbon pores used in his capacitor as in the pores of the etched foils of electrolytic capacitors. Because the double layer mechanism was not known by him at the time, he wrote in the patent: "It is not known exactly what is taking place in the component if it is used for energy storage, but it leads to an extremely high capacity."

The MOS capacitor was later widely adopted as a storage capacitor in memory chips, and as the basic building block of the charge-coupled device (CCD) in image sensor technology. In 1966, Dr. Robert Dennard invented modern DRAM architecture, combining a single MOS transistor per capacitor.



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Technical Topics

Lifting the lid on Antenna Efficiency

Chris Turner, ZS6GM

September 2025

There's a fair bit of myth that small antennas are much less efficient than full size dipoles. The truth is that electrically small antennas can be almost as efficient provided that losses are minimised.

To transfer maximum power to an antenna the transmitter must be impedance matched to the antenna. The feed-line must present a source resistance to the antenna equal to the input resistance and a reactance equal but opposite to the antenna reactance. The input resistance is a combination of the radiation resistance in series with the loss resistance.

Radiation resistance, R_r is an effective resistance defined as the value of electrical resistance that would dissipate the same amount of power as heat as dissipated by the radio waves emitted by the antenna. It is equal to the total power P_{rad} radiated as radio waves by the antenna, divided by the square of the rms current I_{RMS} into the antenna terminals:

$R_r = P_{rad} / I_{RMS}^2$ and may be calculated using the formula:

$$R_r = 80\pi^2 (L / \lambda)^2$$

where L = antenna length and λ is the operation wavelength, in metres.

In the case of a small loop:

$$R_r = 320\pi^4 (A / \lambda^2)^2$$

where A is the area enclosed by the loop.

For large antennas the radiation resistance is large. As the physical size of the antenna becomes progressively smaller compared to the wavelength, so the radiation resistance decreases. Therefore, loss resistance plays a significant

role in determining antenna efficiency.

Note that the feed point resistance is not the same as the radiation resistance for example in the case of an end-fed half wave or an off-centre fed dipole which has an input resistance higher than the radiation resistance.

The efficiency of an antenna is not determined by its physical size but by the losses associated with feeding the antenna. Efficiency is expressed by the Greek letter eta η .

$$\eta = R_r / (R_r + R_{loss})$$

where R_{loss} is the sum of the ground loss, resistive loss and other losses associated with the feed.

So with physically smaller antenna size, loss to heat consumes a larger fraction of the transmitter power, causing the efficiency of the antenna to fall.

For example, in the case of a transmitter perfectly matched to an antenna, if the antenna radiation resistance is 72 ohms and the loss resistance is 10 ohms, then η is 88%. If the radiation resistance is 12 ohms in the case of a short vertical and the loss resistance is 10 ohms, then η is 55%. In the case of a 14 MHz small loop antenna with a Q of 200, the radiation resistance will be 1.1 ohms and loss resistance 0.09 ohms. Excluding ground and environmental losses, the efficiency η will be 93%.

Summary

The perceived efficiency of an antenna is determined not by physical size of the antenna but by the resistive losses in the antenna and in the feed system. The antenna environment and proximity to earth and surrounding objects can absorb radiated energy. And of course the antenna far field radiation pattern determines the received signal strength at a distant station.



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Technical Topics

Replacing germanium transistors with silicon in old radios

Chris Turner, ZS6GM
November 2025

If you are repairing or refurbishing a vintage transistorised or hybrid radio, one of the challenges can be finding replacement small signal germanium transistors. You can use silicon transistors if you change the biasing.

One of the significant differences between germanium and silicon transistors is the base – emitter voltage. For Ge it is around 0.3v and for Si it is around 0.7v. This means the bias point changes, so when substituting devices, the biasing will need to be changed. Also, silicon transistors typically have a much higher gain; as much as ten times.

Most germanium transistor circuits used PNP devices, so make sure that your substitute is the correct type. PNP or NPN as appropriate. Be sure to check the pinout of the original and substitute devices. Another thing to check that the substitute device has suitable maximum frequency response. Check the f_t (transition frequency) of the substitute.

Biasing

Bias point can be adjusted by changing the value of the emitter resistor. In most cases, simply doubling the emitter resistor value will be adequate. For example, in an IF amplifier using a 2SA246 PNP transistor, a 2N3906 or BC337 will do the job. If the emitter resistor is 330 ohms, replace it with 680 ohms.

Gain

Because the gain of modern silicon transistors is much higher than most older germanium devices, it may be necessary to reduce the gain of the substitute circuit, by swamping the collector with a resistor in parallel with the collector load. You want the collector voltage to be similar to the original swing.

A better way is to measure the base, emitter and collector voltages, then replace the transistor, after which, try to get the base and collector voltages close to the same values by adjusting the emitter resistor value.

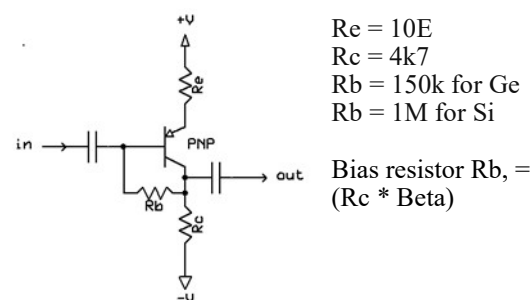
The gain of a Si transistor may be up to 10 times higher than the Ge, so you may have to kill some gain with an extra load resistor so the voltage swing is about the same as with the Ge.

If you are not into the theory and you want to do a more accurate substitution, you could build a test circuit with the Ge transistors, then replace it with your preferred Si device and try to get it to work the same way in simulation, noting the voltages again and the overall gain of the amplifier. You have to pay attention to bias point and transistor gain, adjusting as needed.

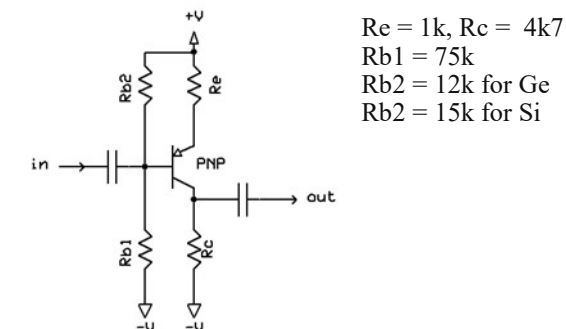
Here are examples of bias circuit values.

Adjust the bias voltage by changing the voltage on the base circuit where Beta is the amplification factor of the transistor. NPN circuits are the same except that +V and -V are reversed.

Example bias values



Example bias values



For a more detailed explanation see the references.

References:

https://mycollegevcampus.com/sjcet/notes/01_Transistor_Biasing.pdf

<https://www.allaboutcircuits.com/textbook/semiconductors/chpt-4/biasing-calculations>

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**Antique Wireless Association
of Southern Africa****Mission Statement**

Our aim is to facilitate, generate and maintain an interest in the location, acquisition, repair and use of yesterday's radio's and associated equipment. To encourage all like minded amateurs to do the same thus ensuring the maintenance and preservation of our amateur heritage.

Membership of this group is free and by association. Join by logging in to our website.

Notices:**Net Times and Frequencies (SAST):**

Saturday 07:00 (05:00 UTC) — Western Cape SSB Net — 7.140; Every afternoon during the week from 17:00

Saturday 08:30 (06:30 UTC) — National SSB Net — 7.125;

Echolink — ZS0AWA-L;

ZS6STN Sandton repeater — 145.700

Kempton Park Repeater — 145.6625

Relay on 10.125 and 14.135 (Try all and see what suits you)

Saturday 14:00 (12:00 UTC) — CW Net — 7025

AWASA Telegram group:

Should you want to get on the AWA Telegram group where a lot of technical discussion takes place, send a message to Andy ZS6ADY asking to be placed on the group. This is a no-Nonsense group, only for AWA business. You must download the Telegram App first.+27824484368

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